

Why One Triaxial Test Result Is Never Enough

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Triaxial testing remains a cornerstone of geotechnical engineering, providing the essential data on shear strength needed to specify foundations, assess slope stability, and design earthworks.

However, according to Matt Hartnup, manager of Lucion Ground Engineering's UKAS-accredited laboratory in Peterborough, the industry often risks over-relying on isolated data points without considering the broader geological picture.

The Trap of the Single Result

A common misconception in ground investigation is that a single laboratory test can represent an entire stratum. "A triaxial test provides a snapshot of one specific sample at a particular depth under controlled conditions," Hartnup explains. "It cannot, by itself, account for the natural variability of soil across a site or identify whether that specific result is a representative average or a statistical anomaly."

In cohesive soils, this variability is often high. When site investigation budgets are "value-engineered" or testing programmes are restricted, this lack of data density leads to uncertainty. This rarely results in immediate structural failure; instead, it leads to designs that are either excessively conservative—driving up project costs—or insufficiently cautious, which heightens long-term risk.

Precision vs. Representativeness

While Quick Undrained Triaxial testing (under BS EN ISO 17892-8:2018) is a highly precise laboratory process, Hartnup stresses the distinction between laboratory precision and site-wide representativeness.

“A lab specimen is a tiny fraction of the soil volume that will actually support a structure,” he notes. “Small-scale testing cannot capture macro-geological features like fissures, discontinuities, or large-scale bedding planes. Furthermore, every sample undergoes some degree of disturbance during extraction, a factor engineers must account for during the design phase.”

The Value of Integrated Data

The true engineering value of triaxial testing is unlocked only when the results are integrated with borehole logs, in-situ testing, and the overall geological model. Viewing lab numbers in isolation can lead to false confidence.

By contrast, a comprehensive testing programme, utilising multiple samples across various depths and locations, allows engineers to:

- Identify clear geological trends.
- Isolate and understand anomalies.
- Build a high-confidence ground model.
- Design more efficient foundations and safer excavation strategies.

Managing Construction Uncertainty

Ground risk remains one of the most significant variables in any construction project. As pre-construction schedules tighten and budgets are scrutinised, the pressure to limit the scope of testing often increases. However, reducing the amount of data seldom reduces the actual risk; it simply pushes that uncertainty further into the project lifecycle, where it becomes more expensive to manage.

“Triaxial testing is an incredibly robust tool when conducted correctly,” Hartnup concludes. “But it is only one piece of a complex puzzle. The real expertise lies not just in generating a number, but in understanding what that number signifies within the context of the entire ground model.”